A Primer on Safety Performance Measures for the Transportation Planning Process

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16. Abstract

This Primer is a tool to help State and local practitioners, transportation planners, and decision-makers identify, select, and use safety performance measures as a part of the transportation planning process. The Primer draws from current literature, professional experience, and State DOT and MPO practice. Key elements of the Primer include: a definition of performance measures; a step-by-step description and flowchart showing how safety performance measures can be identified and integrated into the transportation planning process; characteristics of effective performance measures; a checklist to assess an organization's current status with respect to the use of safety performance measures in the transportation planning and decision-making process; a list of references; and case studies of noteworthy practice.

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FORWARD

To promote a safer transportation system, we want to share with you this report, "A Primer on Safety Performance Measures for the Transportation Planning Process." This is a first step towards employing safety performance measures in the transportation planning process.

This report introduces the concept of integrating safety performance measures into the transportation planning process. It outlines the benefits of using safety performance measures in planning, as well as basic information on what are safety performance measures. This document includes a high level step-by-step approach for developing safety performance measures.

To give the reader a better understanding of what is discussed in this primer, seven case studies have been included in the document. The case studies highlight the experience and application of the States and metropolitan planning organizations that have developed and used safety performance measures.

This primer will be of interest to transportation planning and safety practitioners, in particular those in State departments of transportation, metropolitan planning organizations, and other organizations involved in transportation decision-making. It provides information to assist planners with incorporating safety performance measures into the transportation planning process in an effort to improve safety of the transportation system.

Sincerely yours,

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INTRODUCTION

In 2008 more than 37,000 people were killed and nearly 2.35 million were injured in crashes on the Nation's roadways (Source 1). The consequences of traffic crashes are felt not only by those directly involved but also by family members, friends, and coworkers who must deal with a devastating loss or find resources to cope with disabling injuries. The costs to society such as lost productivity, property damage, medical costs, emergency services, and travel delays are also tremendous.

For these reasons improving safety is one of the primary goals of transportation officials. Years of experience with safety projects and strategies have shown that benefits associated with efforts to improve transportation safety far outweigh the resources consumed.

The most critical safety benefit is a decrease in the number of fatal and injury crashes that occur each year on streets and highways across the Nation. Motor vehicle crashes are the sixth leading cause of death and the leading cause of injuries in the United States. Beyond the pain and suffering of victims and their friends and relatives, these crashes are a significant economic burden to the Nation. In 2004, the American Association of State Highway Officials (AASHTO) estimated traffic crashes in the United States accounted for over $230 billion in economic losses every year (Source 2). Improving safety not only saves lives, but also produces other societal, environmental, and monetary benefits, such as greater mobility, increased economic development, and improved quality of life.

A study of the societal costs of congestion compared to the cost of crashes conducted by AAA in 2008 showed in the top 85 metropolitan areas in the United States crash per capita costs ranged from 1.3 to 4 times greater than congestion costs.

(Source 3)

Transportation system improvements are initiated in the transportation planning process. Every urbanized area in the country uses a planning process to identify those transportation system improvements that most effectively address the needs of the community. Consideration of safety issues during the transportation planning process is important to improving transportation safety, as it enables the funding of safety related projects. Proper safety performance measures are key to ensuring that safety issues are considered and addressed throughout the transportation planning process.

One particularly important benefit of performance measures is the information generated through their use over time. Consistent analysis of data reflecting safety performance of the transportation system is particularly important for identifying goals to guide transportation planning efforts and focusing attention and resources on safety-related challenges, as well as monitoring progress toward their achievement. Over the past 15 years, the transportation profession has increasingly used performance measures as the primary mechanism for providing this information. Information collected through the use of safety performance measures are used to prioritize investments, demonstrate progress toward goals in statewide and metropolitan long-range transportation plans, implement statewide and metropolitan transportation improvement programs (S/TIP), and monitor overall system performance. The S/TIP is a resource-constrained program that identifies the projects to be implemented.

This *Primer* is a tool to help State and local practitioners, transportation planners, and decision-makers identify, select, and use safety performance measures as a part of the transportation planning process. The Primer draws from current literature, professional experience, and State DOT and MPO practice. Key elements of the Primer include the following:

- A definition of performance measures;
- A step-by-step description and flowchart showing how safety performance measures can be identified and integrated into the transportation planning process;
- Characteristics of effective performance measures;
- A checklist to assess an organization's current status with respect to the use of safety performance measures in the transportation planning and decision-making process;
- A list of references; and
- Case studies of noteworthy practice.

WHAT ARE SAFETY PERFORMANCE MEASURES?

Performance measures are indicators that enable decision-makers and other stakeholders to monitor changes in system condition and performance against established visions, goals, and objectives. Typical safety performance measures relate to the number and rate of fatalities and/or crashes and incidents, emergency response times, public perceptions of safety, etc., for the relevant transportation modes.[1]

Safety performance measures provide the following benefits to the planning and decision-making process (Source 4):

- Greater accountability to policy-makers, customers, and other stakeholders;
- Greater linkage between the safety goals/objectives identified through long-range planning and policy formulation;
- A better understanding of the impacts of alternative courses of action aimed at improving transportation system safety;
- Improved communication about transportation safety to customers, political leaders, the public, and other stakeholders;
- Increased organizational focus on safety priorities; and
- Information feedback to promote ongoing improvement of business processes as they relate to supporting safety strategies.

Safety performance measures should be relevant to the safety issues and policy/strategy initiatives in a jurisdiction. The number and rate of fatalities, injuries, and/or crashes are commonly used safety performance measures. However, given that safety issues vary across the country, no single set of safety performance measures is applicable to every State and region.

The National Highway Traffic Safety Administration (NHTSA) and the Governors Highway Safety Association (GHSA) have developed a set of safety performance measures that each State will be required to track beginning in Federal fiscal year 2010 (see Table 1). Some of the performance measures listed in the table below (i.e., counts and rates of fatalities, number of serious injuries, number of speeding-related fatalities, and number of pedestrian fatalities) are common to both the infrastructure and behavioral transportation safety area. As State DOTs,

[1] Performance measures are different from evaluation criteria, which relate to assessing the relative safety benefits or costs of specific projects or for prioritizing alternative safety strategies. The level of detail associated with evaluation criteria is greater than that associated with performance measures.

MPOs, and other transportation safety stakeholders move forward with developing safety performance measures for the transportation planning process they can take advantage of these data and adopt some of these safety performance measures if appropriate.

Table 1. Safety Performance Measures (Source 5)

Core Measures	Description	Data Sources
C-1	Number of traffic fatalities (three-year or five-year moving averages)	FARS
C-2	Number of serious injuries in traffic crashes	State crash data files
C-3	Fatalities/VMT (including rural, urban, and total fatalities)	FARS, FHWA
C-4	Number of unrestrained passenger vehicle occupant, all seat positions	FARS
C-5	Number of fatalities in crashes involving a driver or motorcycle operator with a blood alcohol concentration of .08 g/dL or higher	FARS
C-6	Number of speeding-related fatalities	FARS
C-7	Number of motorcyclist fatalities	FARS
C-8	Number of unhelmeted motorcyclist fatalities	FARS
C-9	Number of drivers 20 or younger involved in fatal crashes	FARS
C-10	Number of pedestrian fatalities	FARS
B-1	Observed seat belt use for passenger vehicles, front seat outboard occupants	Survey
A-1	Number of seat belt citations issued during grant-funded enforcement activities	Grant activity reporting
A-2	Number of impaired-driving arrests made during grant-funded enforcement activities	Grant activity reporting
A-3	Number of speed citations issued during grant-funded activities	Grant activity reporting

C= Core measure; B = Behavioral measure; A = Activity measure

The safety performance measures in Table 1 are organized in three categories representing the types of measures often found in practice:

- **Core measures** (also known as outcome measures) relate to the safety goals and objectives established as part of policy or as part of a planning process. These measures allocate resources and measure overall progress. They may include crashes, injuries, and fatalities and can be presented as numbers, rates, percentages, or ratios.
- **Behavioral measures** provide a link between specific safety activities and outcomes by assessing whether the activities influenced behavior. These may include direct observations of safety belt use and vehicle speed or self-reported behavior pertaining to program awareness and attitude obtained through surveys.
- **Activity measures** document safety program implementation and track actions taken by law enforcement, courts, media, education, and others to reduce crashes, injuries, and fatalities.

In addition to the safety performance measures developed by NHTSA and GHSA, some examples of infrastructure-related safety performance measures that can be considered for inclusion in the transportation planning process may include:

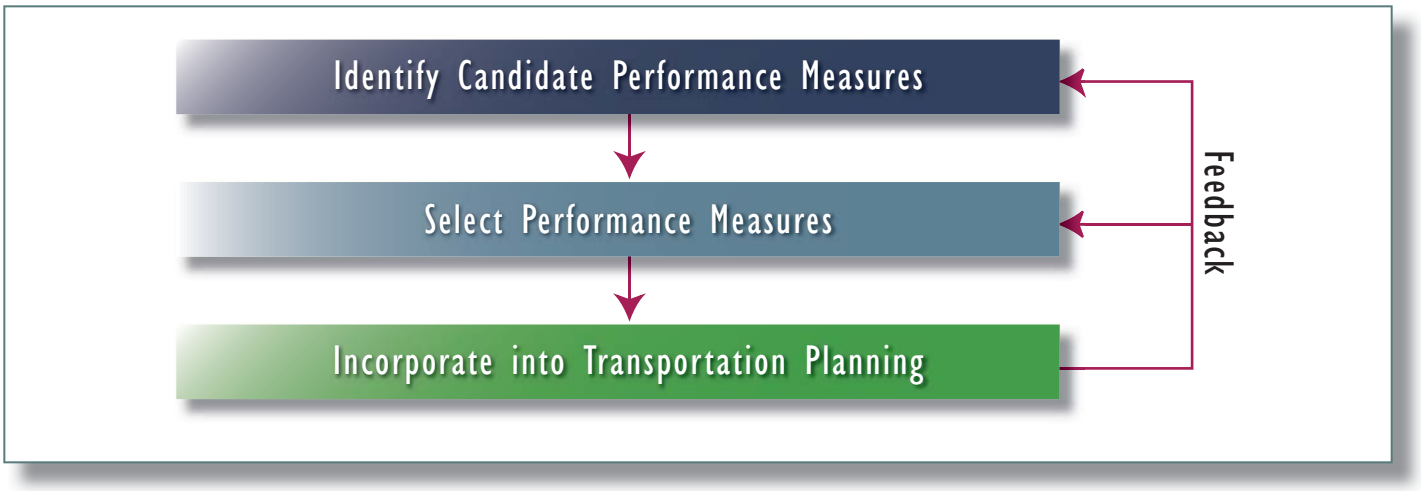
- Number of run-off-the-road crashes *(core measure)*;
- Number of fixed object crashes *(core measure)*;
- Number of intersection crashes *(core measure)*;

- Miles of guard cable installed *(activity measure)*;
- Miles of rumble strips installed *(activity measure)*;
- Number of medians installed *(activity measure)*;
- Number of signs updated or warning signs installed *(activity measure)*; and
- Number of intersections with improved signal timing *(activity measure)*.

PROCESS FOR INCORPORATING SAFETY PERFORMANCE MEASURES INTO TRANSPORTATION PLANNING

A high-level process illustrating the three major steps to incorporating safety performance measures into transportation planning is shown in Figure 1 below. For States and metropolitan areas already using safety performance measures, these steps can help identify new measures and/or enhance existing ones. If performance measures are not currently used, these steps can help identify, select, and incorporate them into the transportation planning process.

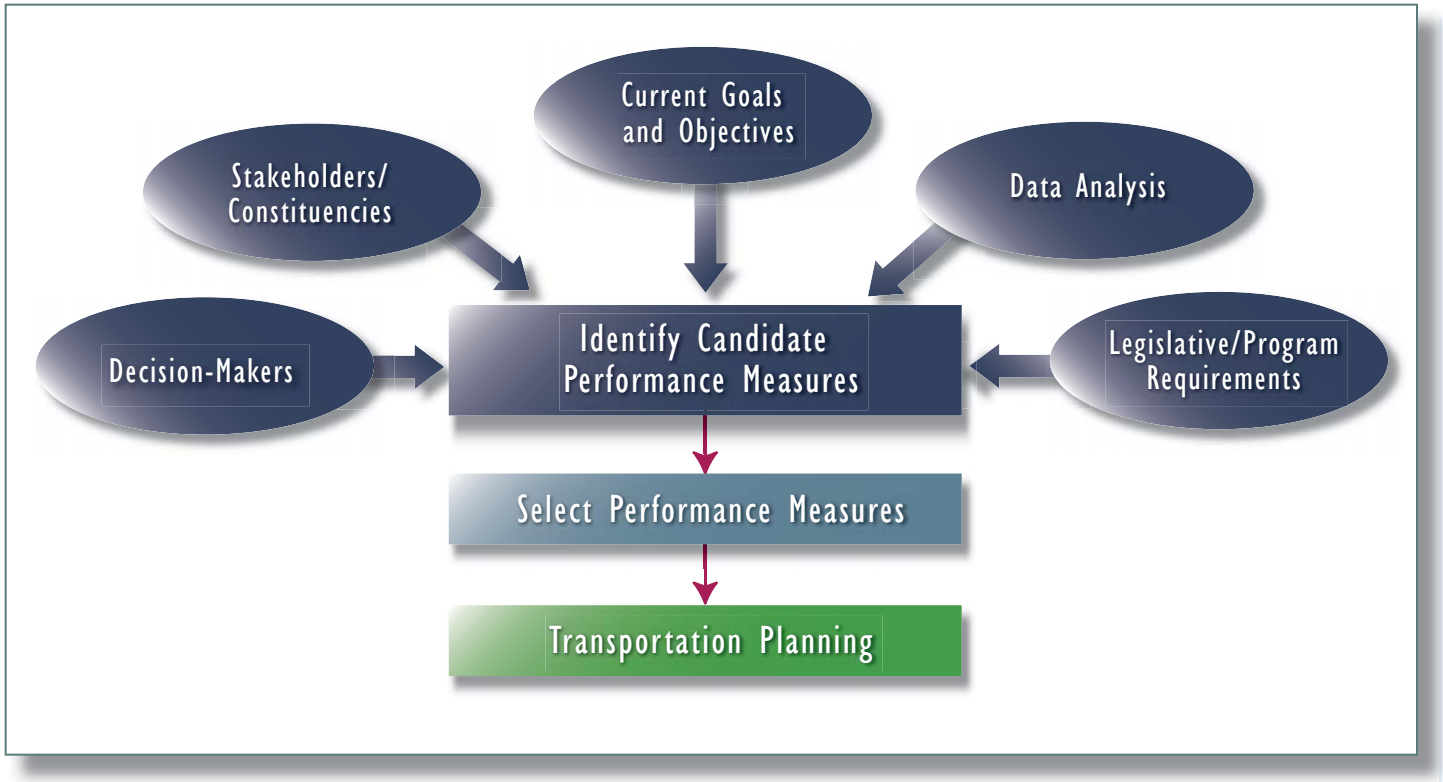
Figure 1. Transportation Safety Planning Performance Measures



IDENTIFY CANDIDATE SAFETY PERFORMANCE MEASURES

Safety performance measures originate from many sources, including current goals and objectives, safety data analysis, legislative and program requirements, decision-makers, stakeholders, and other constituencies (see Figure 2).

Figure 2. Sources of Candidate Safety Performance Measures



Current Goals and Objectives

A typical transportation planning process includes a set of goals and objectives that reflect the values and desires of the community. These goals and objectives provide guidance to transportation officials and analysts, and highlight the types of information required to measure progress toward achieving them. Most State and regional planning processes have goals related to system preservation, mobility and congestion, economic development, safety, environmental quality, and financial responsibility. Developing safety performance measures and aligning them with the planning goals and objectives help decision-makers design and implement strategies and projects that support the community's values.

Figure 3. Sample SHSP Performance Measures

- Number of run-off-road fatalities
- Number of intersection-related fatalities
- Number of speeding-related fatalities
- Number of fatalities involving distracted drivers
- Number of fatalities in unlicensed-driver crashes
- Number of fatalities involving 16-19 year-old drivers
- Number of motorcyclist fatalities
- Number of fatalities involving heavy trucks

Safety-related goals can originate from within the transportation planning process or be brought into the process from other state or regional safety planning efforts. Strategic Highway Safety Plans (SHSP) include many safety-related goals that lead to performance measures such as those listed in the Figure 3. The SHSP is a data-driven, comprehensive, multidisciplinary strategic plan developed in collaboration with Federal, State, local, and private sector safety stakeholders. It identifies priorities and drives investment decisions by establishing statewide safety goals, objectives, and emphasis areas. As a part of the SHSP process some States have developed performance measures to

further guide safety improvement efforts. Additional safety-related goals and information can be drawn from other safety plans and programs, such as the Highway Safety Improvement Program, Highway Safety Plan, and/or Commercial Vehicle Safety Plan.

Data Analysis

Most transportation planning efforts begin with a preliminary analysis of the challenges facing the system. In almost all cases, this ongoing effort continually identifies new issues and feeds them into the planning process. For example, regional planning analysts often conduct corridor studies that provide details on the types of challenges and system deficiencies found in a portion of the region. Improving overall transportation safety within the corridor is almost always a major goal of such studies. Data analyses focus on identifying intersections and other high-crash locations in the corridor, followed by more detailed investigation of the types of strategies that can be used to reduce crashes. Corridor studies suggest strategies and recommend projects for the long-range transportation plan and for the S/TIP program.

Figure 4. Southeast Michigan Council of Governments Safety Performance Indicators

- Reduce traffic crashes, particularly between modes
  - Percent of total Regional Transportation Plan investment spent on safety
  - Frequency and rate of traffic/injury/fatal crashes
  - Frequency and rate of traffic crashes between modes: autos, trucks, rail, transit, pedestrians, and bicyclists
- Increase transit safety and security for riders and employees
- Number of transit crashes
- Number of transit incidents
- Percent accessible bus stops

(Source 6)

Monitoring of transportation safety problems (e.g., run-off-the-road crashes, alcohol-related crashes, pedestrian/bicycle crashes, and transit incidents, etc.) results in collection and analysis of data useful for developing performance indicators such as those in Figure 4. The SHSP development and associated update activities also provide potentially valuable data about the safety challenges facing a state. For example, SHSP contain emphasis areas (e.g., lane departures, intersections, occupant protection, etc.) identified through the data analysis. The emphasis areas, and the analyses associated with them, provide a rich data source for the development of safety performance measures. Similar analyses from other safety programs and plans, such as the highway safety improvement program, can serve the same purpose.

Stakeholders/Constituencies

Transportation planning stakeholders often identify safety issues critical to their interests. For example, Mothers Against Drunk Driving, AAA, pedestrian and bicycling advocacy groups, the trucking industry, and the public health/medical establishment are interested in transportation safety issues specific to their missions. Transportation officials might consider developing safety performance measures that align with major public safety issues and with the concerns of important interest groups. For example, performance measures could be used to monitor the proportion of all fatalities involving lane departures, impaired drivers, or commercial motor vehicles.

Legislative/Program Requirements

Sometimes transportation officials develop safety performance measures in response to legislative, regulatory or other higher authority requirements, such as the NHTSA/GHSA requirements referenced in Table 1. Such requirements will likely increase as government programs become more performance-oriented with a greater concern for transparency to the public.

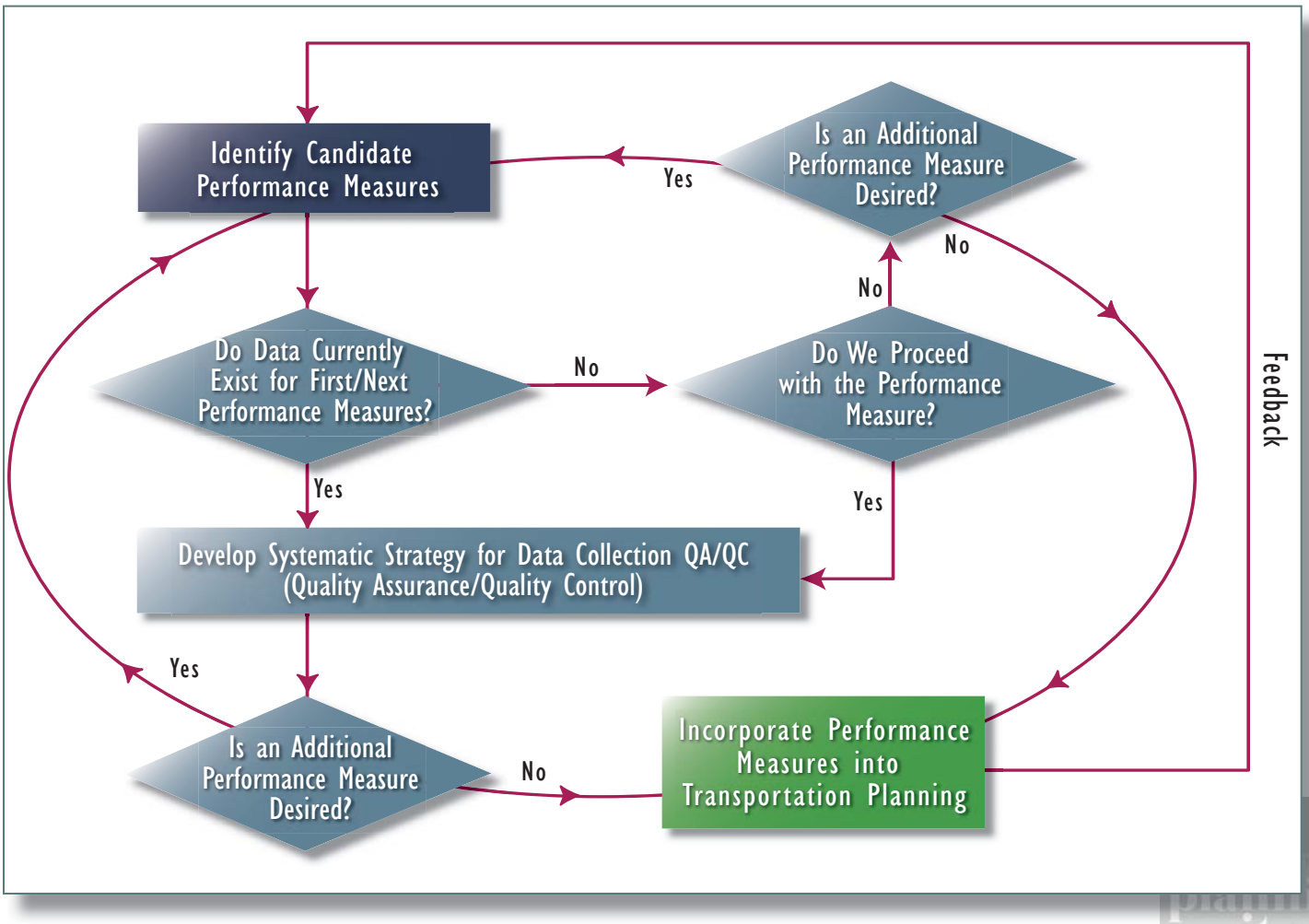
Decision-Makers

People who make investment or operational decisions and establish laws or policies might identify the information required to make better decisions in the future. Indeed, one of the original motivations for developing transportation performance measures was the state legislature's desire to know the benefits of transportation investments and expenditures. Some commonly used information include the following: data on the safety of the transportation system (e.g., fatalities, injuries, or crashes); results of targeted initiatives (e.g., the reduction in crashes after installation of traffic signal upgrades or the number of driving under the influence (DUI) arrests or crashes where alcohol was a factor following an impaired driving program), and data on the safety concerns of interest to key constituencies (e.g., fatalities and injuries to young drivers or pedestrians). Decision-makers also focus on output measures such as the number of citations issued, number of road miles with guardrails, or the number of high-crash sites that received treatment. These types of performance measure-based information are the foundation of a transparent and accountable policy-making process.

SELECT SAFETY PERFORMANCE MEASURES

A process for selecting candidate safety performance measures is shown in Figure 5 below. It recognizes that the most important issue transportation agencies face when considering candidate performance measures is *data availability*.

Figure 5. Selecting Safety Performance Measures for the Transportation Planning Process



The candidate performance measures identified in the previous section are reviewed and examined as follows:

- Do data supporting the performance measure exist?
- If data exist, then a strategy for collecting it systematically over time should be identified.
- If data do not exist, the question then becomes, "Do we proceed with the safety performance measure anyway?"
- If yes, then one has to identify a strategy for systematically collecting the data.
- If no, one proceeds to examine the next candidate measure.

While the selection of safety performance measures is described as a sequential process, in reality all performance measures will likely be reviewed at the same time. After the candidate safety performance measures have been considered, those that are selected need to be incorporated into the transportation planning process.

Determine if Data Exist to Support the Candidate Performance Measure

The question should always be asked, "Are sufficient data available to support a candidate safety performance measure?" Experience has shown that performance measures are often selected based on their appeal as "good information to have," only to discover that the necessary data do not exist and/or that data collection is prohibitively expensive. This initial step simply determines if data resources are currently available to support the performance measure. Such a determination relies on interaction with the data collection and processing units within the responsible agencies.

Often, the required data are collected by various agencies for a variety of purposes. Transportation planners should build the necessary relationships to enable them to access and use the data sources to measure transportation safety performance.

The NHTSA has identified six core data systems for use in a highway safety performance measurement system (Source 8):

- **Crash** – available police officer crash reports;
- **Vehicle** – information on licensed vehicles (also known as the vehicle registration system);
- **Driver** – information on licensed drivers and driver histories – also known as the driver license and driver history system;
- **Roadway** – information about all publicly owned roadways, including roadway centerline and geometric data, location reference data, geographical information system data, travel and exposure data, etc.;
- **Citation and adjudication** – information on traffic citations from the time they are assigned to an officer, through the court adjudication system and ultimately into the driver history file data system; and
- **Injury surveillance** – information on motor vehicle injuries and deaths.

Some of these systems are more obviously related to the transportation planning process, such as crash and roadway data systems, than others are. While the level of relevance varies depending on the priorities of a given agency, each of these systems generates useful data for highway safety performance measurement.

For transit, the most frequently-used types of data include ridership (broken down by demographics), vehicle and passenger miles traveled, and number of trips. To estimate crash risk for example, one might use measures such as 0.24 injuries per 100 million passenger miles traveled or 0.15 injuries per 100,000 riders.

Table 2. Ranking of Safety Data Used by State DOTs and MPOs

Data Source	MPO	State DOT
Vehicle crashes	1	1
Vehicle miles traveled	2	4
Roadway inventories	3	2
Injury/fatality	4	3
Pedestrian crashes/injuries	5	6
Bicycle crashes/injuries	6	7
Property damage	7	8
Air quality/emissions	8	9
Air transport crashes	9	10 (tie)
Transit/paratransit incidents	10 (tie)	10 (tie)
Water navigation crashes	10 (tie)	15
Safety belt/restraint use data	12	14
Emergency medical response	13	16
DUIs	14	12
Rail crashes	15	5
Accident investigation	16	12

(Source 7)

The most commonly used safety data source for transportation planning is a crash data management system. It provides the time, location, environment, characteristics, and contributing crash factors, such as obstructed view, alcohol impaired driver or pedestrian, red light running, etc. Crash information should link to other sources of information as well, (i.e., roadway inventory, driver history, etc.) and provide details on the roadway, vehicles, and people involved in the crash. Crash consequences, such as fatalities, injuries, property damage, and traffic violations are also available through the crash data management system.

Crash data can be used for analysis of a single crash or aggregated for statewide, regional, or corridor planning. A State crash data system should accommodate information on all reportable motor vehicle crashes on any public roadway. In most States, a Traffic Records Coordinating Committee (TRCC) or Traffic Records Committee provides oversight and guidance for developing consistent traffic safety records. The TRCC is helpful for coordinating the many different safety-related data collection and data management activities in a State. If not already involved, transportation planners are encouraged to work with their State TRCC.

The results of a recent survey of State DOTs and MPOs on the types of safety data used in transportation planning are shown in Table 2. Not surprisingly, vehicle crashes, vehicle miles traveled, and roadway characteristics are in the top five for both State DOTs and MPOs. Pedestrian crashes also are highly ranked. Rail crashes are in the top five for State DOTs because of their special responsibility for highway/railroad grade crossing safety programs, particularly in rural areas.

Ensure a Strategic Data Collection Plan is in Place with Appropriate Quality Assurance/Quality Control Procedures

If data to support a safety performance measure are available, a strategy for systematic data collection over time must exist. Such strategies require that data collection schedules, organizational roles and responsibilities, needed resource allocations, and data collection methodologies are incorporated into the standard procedures of the implementing agencies. Importantly, a careful examination of the collection strategy should be made to assure the data meet the quality standards and schedule needs to support the safety performance measures. The following characteristics, identified by NHTSA (Source 8), are critical data collection factors for consideration as part of an overall data management strategy:

- **Timeliness** – the data system custodian should produce crash reports and crash data in a timely manner to inform the performance measurement process;
- **Accuracy** – the data need to be accurate, whether as originally collected or in their final electronic format;
- **Completeness** – data records should include all crash characteristics so the analyses incorporate all factors and improve understanding of the behavioral and/or physical contributing crash and injury factors;

- **Uniformity/Consistency** – uniformity and consistency in the data base is critical – for example, statewide uniform codes and single crash report forms assure consistency in reporting;
- **Integration** – at the State level, databases should be developed to allow the compatible transfer of data from one database to another – ideally one database is used by all safety-related agencies at all levels of government; and
- **Accessibility** – data need to be accessible for safety analyses and planning studies.

Other characteristics of performance measures to consider include (Source 8):

- **Multimodality** – does this measure or set of measures encompass all relevant modes, and thus require data from a variety of sources?
- **Geographic Scale** – is the measure applicable to all areas of the State, region, or locality and does it require data at different levels of aggregation? Can it discriminate between freeways and other facilities? Is it useful at a regional, subarea, or corridor level?
- **Forecastability** – will the measure compare future alternative projects or strategies? Is it difficult to predict future conditions using the measure given existing forecasting tools?

INCORPORATE SAFETY PERFORMANCE MEASURES INTO TRANSPORTATION PLANNING PROCESS

Although transportation planning is performed in numerous jurisdictions for a variety of reasons, several elements of the planning process are common among them. Figure 6 below outlines the general transportation planning process from developing vision and goals to monitoring system performance (Source 9). The figure shows that linkages between safety performance measures and the transportation planning process exist for each element.

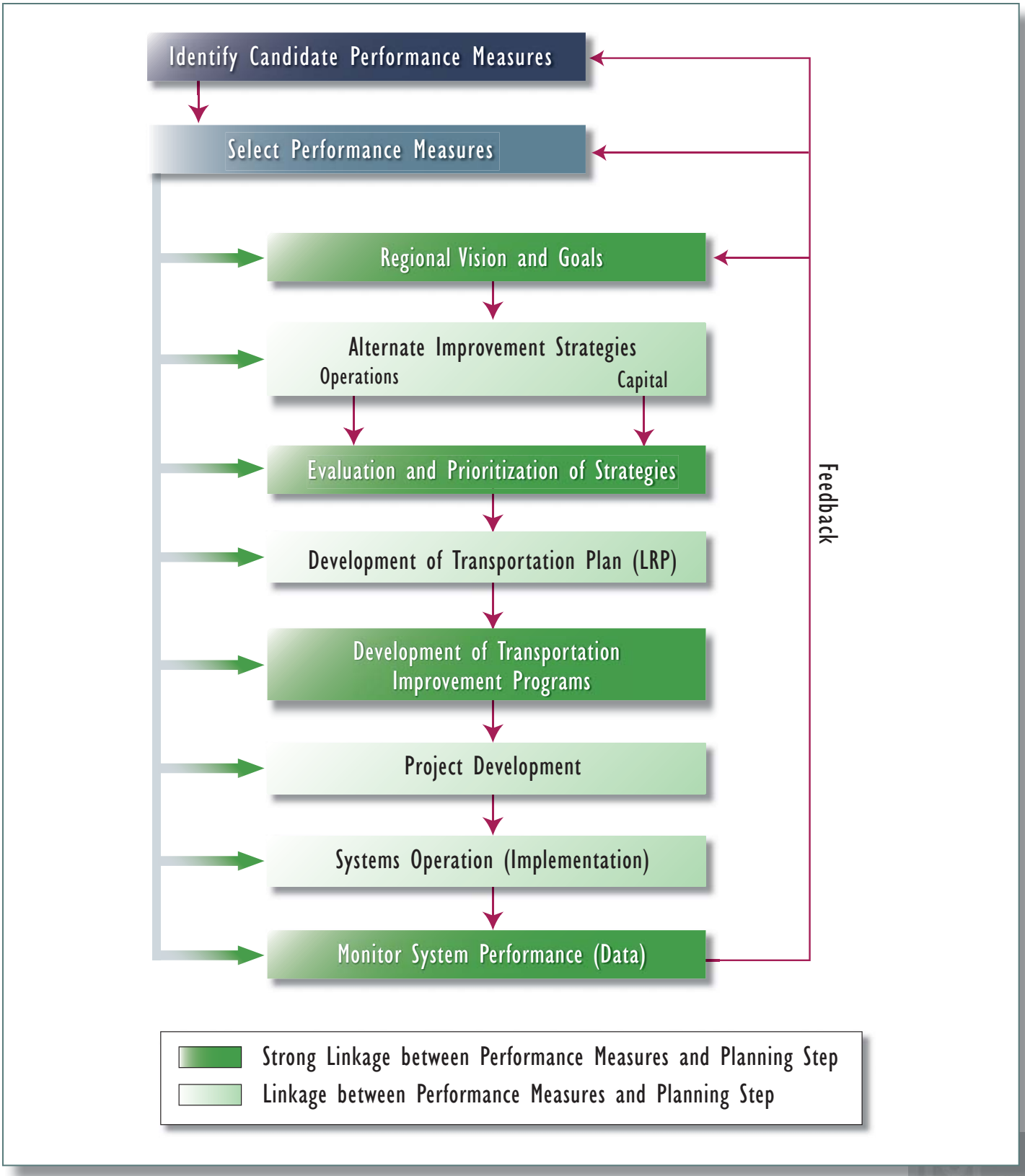
Element 1 – Regional Vision and Goals

Incorporating safety performance measures into a transportation plan's vision, goals, and objectives leads to the implementation of more projects with safety components and benefits. This is primarily because integrating performance measures in this initial step results in subsequent planning steps also doing so (e.g., use of safety criteria in project evaluation). A community's transportation vision and corresponding goals and objectives should have a strong, two-way linkage to safety through the establishment of performance measures. Safety performance measures that support the plan's goals and objectives are then aligned with what decision-makers, stakeholders and others in the community value. Another benefit of incorporating safety into the visioning process is that those involved become aware of safety's importance, which is instrumental in building constituencies to support safety projects through the remaining planning steps.

Element 2 – Alternate Improvement Strategies

Linking safety performance measures to the identification of improvement strategies can lead to the implementation of projects and strategies that save lives and reduce safety-related economic costs to society. For example, performance measures that focus on reducing pedestrian-vehicle crashes could encourage the development of programs to identify and improve locations where such crashes are likely to occur. Likewise, performance measures that focus on lane departure crashes can lead to programs to reduce their occurrence and limit their severity. Strategies developed in response to robust safety-related performance measures can be either operations-oriented (e.g., improving incident management programs or using intelligent transportation systems to monitor crash occurrences), infrastructure-oriented (e.g., implementing a "hot-spot" program to improve geometric designs at high crash locations or improving transit station configurations to reduce vehicle-pedestrian conflicts), or both.

Figure 6. Relating Safety Performance Measures to Individual Steps in the Transportation Planning Process



Element 3 – Evaluation and Prioritization of Strategies

Properly designed safety performance measures are essential to the evaluation and prioritization of strategies. This is where improving safety takes its rightful place next to the other planning considerations (e.g., system preservation, improving accessibility, reducing congestion, etc.). The planning process estimates the relative effectiveness of various strategies and prioritizes capital and maintenance investments based on evaluation criteria. Effective safety performance measures lead to safety-related evaluation criteria. For example, if "number of crashes" is a safety performance measure, it would be important to evaluate proposed projects and strategies from the perspective of their impact on the number of crashes. The benefit of linking safety performance measures to the evaluation and prioritization step is that more safety-related projects will emerge from the planning process. This will ultimately lead to a reduction in the number of crashes and fatalities.

Element 4 – Development of Transportation Plan (Long-Range Plan)

The use of safety performance measures throughout the planning process will lead to the selection of more projects and strategies with safety benefits. Given that the Long-Range Plan (LRP) represents a strategic perspective on the future of the State or regional transportation system, incorporating safety into the LRP, through the use of safety performance measures, ultimately leads to reductions in crashes and fatalities.

Element 5 – Development of Transportation Improvement Programs

The linkage between performance measures and S/TIP adoption is one of the most crucial in the transportation planning process. Having strong safety performance measures leads to the development of prioritization criteria that include safety and result in more safety-related projects being selected for the S/TIP. For example, the Denver Regional Council of Governments (DRCOG) applies more weight, or safety points, to roadway improvements that have higher crash reduction potential (see Figure 7). This results in a capital program for a State or region that includes projects that reduce the number and severity of crashes. If decision-makers want a greater emphasis on one type of project over another (e.g., those having a greater impact on system safety), assigning greater weight to the related prioritization criteria is one way to do so.

Figure 7. Safety Points for Roadway Reconstruction or Operational Improvements – Denver

DRCOG	Estimated Crash Reduction Potential (crashes over 3 years per mile)			
	Low 0-9 Fewer	Medium 10-19	High 20-29	Very High 30+
Crash Range	Safety Points to Be Awarded			
< State Average	0	1	3	4
1-2 x State Average	1	2	4	5
2-3 x State Average	2	4	5	6
> 3 x State Average	3	5	6	7

(Source 10)

Element 6 – Project Development

To the extent that it is identified as a planning concern and incorporated into the planning process, safety will have a role in detailed project analysis. The project development step examines specific engineering and environmental details in designing and preparing a project for construction. Depending on the size and expected significance of environmental impacts, the project development process may also entail substantial environmental analysis. Safety performance measures provide additional guidance on the types of designs and operational strategies that should be considered as part of the project design (e.g., median barriers to reduce cross lane crashes, reflective signage, sidewalks and bike paths, or construction work zone safety initiatives).

Element 7 – Systems Operations (Implementation)

The impact of safety performance measures in this step can be identified by the manner in which projects and strategies are implemented. An emphasis on safety in program implementation may be reflected in safety conscious land use and urban design standards; enhanced safety design standards; improved safety operational strategies for vehicles (i.e., congestion), pedestrians, and bicyclists; and work zone safety programs.

Element 8 – Monitor System Performance (Data)

The benefit of including safety performance measures as part of a system monitoring program is that safety issues are identified earlier and addressed as part of the planning process, leading to the adoption of strategies or the implementation of projects that will improve the safety performance of the transportation system. This early identification of safety challenges and eventual solutions can result in implementation savings in that investments can be made before the safety challenge reaches a point where higher levels of resources would be necessary.

Ongoing monitoring of system performance provides data and information that should be fed back into the goals and performance measures. A well designed monitoring process can indicate where and when course corrections are needed to improve safety performance. System monitoring consists of the traffic surveillance, traffic counting, transit ridership, review of traffic records databases (including crash data), and other means of determining the performance of the transportation system. Monitoring is done by a variety of agencies and the results are incorporated back into the planning process.

Feedback on Program Effectiveness

Accurately measuring the impact of implemented actions benefits the planning process and decision makers in that both become aware of what types of safety projects, strategies, and countermeasures are most cost effective. This permits decision-makers to target their limited resources on those projects and strategies that are likely to result in the greatest reduction in crashes and fatalities. The post-implementation evaluation or assessment process helps determine the effectiveness of such countermeasures. Without it, no information is available to assess the actual benefit of the countermeasure and justify its future use. Funds should be set aside to allow a proper, scientific evaluation of the countermeasures whenever possible. A proper evaluation considers other variables that could have an effect on the number and/or severity of crashes, such as changes in the number of vehicles using the corridor (e.g., exposure), changes in demographics (proportion of older or younger drivers in the area), etc. While transportation planners do not perform the evaluations themselves, they should be kept informed of the results.

ASSESSING YOUR ORGANIZATION'S USE OF SAFETY PERFORMANCE MEASURES

The following questions will help stakeholders review opportunities for developing safety performance measures and linking them to transportation planning and programming. This checklist is a tool for assessing an organization's current status in using safety performance measures in the transportation planning and decision-making process. The answers to these questions should be used to strategically identify actions that lead to the use of safety performance measures in planning and programming.

1. Is safety included in your agency's vision?
2. What safety challenges are facing your transportation system?
3. Is safety included in your planning vision, goals, and objectives?
4. Are safety performance measures currently used as part of the planning and decision-making process?
5. Are the safety performance measures related to the safety challenges?
6. Are (additional) safety performance measures needed or desired?
7. Who will be responsible for data collection and interpretation?
8. Has the proposed set of performance measures been discussed with those in the agency responsible for collecting data to ensure feasibility and accuracy of data collection?
9. Has a data collection strategy been formulated and implemented for the safety performance measures?
10. Do the evaluation criteria used in the planning process include criteria relating to safety performance measures?
11. Will the safety performance of the transportation system (as defined in the performance measures) likely respond to the types of strategies and projects that result from the planning process? If not, how are such strategies or projects furthered as part of the planning process?
12. Does the project prioritization or ranking scheme include criteria or indices related to the safety performance measures?
13. Are safety performance measures included in the system monitoring process?

Once these questions have been answered and an overall assessment of the current use of safety performance measures has been conducted, the process described in this document should be used to identify additional safety performance measures. In addition, the existing safety performance measures can be modified to increase their effectiveness.

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CASE STUDY: PERFORMANCE-BASED PLANNING AND INVESTMENT MANAGEMENT

CASE STUDY HIGHLIGHTS

- Utilizes overall safety performance measures and sub measures specific to safety issues, modes, etc.
- Provides uniform, performance-based process to identify safety investments.
- Identifies specific countermeasures needed to target most frequent crash types.

The Minnesota Department of Transportation (MnDOT) uses safety-related planning performance measures to identify investment needs. District-Level Investment Plans identify priorities based on projected revenue and investments needed to adhere to policies and meet performance goals as outlined in the Statewide Transportation Plan.

Minnesota's Statewide Transportation Plan (2009 to 2028) focuses on 10 policies, one of which is Traveler Safety. The numbers of fatalities and serious injuries for all travel modes are identified as the highest level safety performance measures. Additional sub-measures related to specific modes include, among others, motorcycle, pedestrian, and commercial-related fatalities. MnDOT also tracks the share of fatal and severe or incapacitating injuries on urban and rural roads and dollars spent on Highway Safety Improvement Program (HSIP) Stand Alone Safety Projects to understand how well traveler safety is being addressed. MnDOT developed system performance targets using historical data, customer research, engineering analysis, economic analysis, fiscal trends, and institutional values.

As a part of the statewide transportation plan update, MnDOT districts updated their long-range Highway Investment Plans. These 20-year investment plans provide the link between the policies and strategies established in the Statewide Plan and capital improvements on the State highway system.

MnDOT established a process and guidelines to ensure District Investment Plans were developed in a consistent manner and planned improvements address statewide goals and investment priorities. The development process began with the identification of highway system needs and revenue projections for each of the three planning periods. Investment goals were then used to develop the State Highway Safety Investment Plan. Unfunded needs also are prioritized. A working group of MnDOT and FHWA safety and traffic engineers established treatments, application criteria, and cost estimates for roadway enhancements. Application criteria are used to assess all State highways and identify when and where improvements are needed.

Investments can be broadly characterized as roadway enhancements or capacity improvements. Roadway enhancements emphasize systemwide, cost-effective strategies that target the types of crashes occurring most frequently on rural highways in the State. The most frequent crash types account for nearly 70 percent of the State's fatalities. Typical enhancements may include, but are not limited to, edge treatments, centerline rumble strips, rural intersection enhancements, turn lanes, passing lanes, full shoulders, and cable median barriers. In most cases roadway enhancement improvements are constructed as part of other, larger highway projects. Capacity improvements are intended to reduce or eliminate vehicle conflicts at locations meeting specific traffic volume thresholds. These projects are generally higher-cost strategies and are initiated as stand-alone projects.

Results

MnDOT's performance-based investment plan enables the State to estimate the investments needed to meet established performance measure targets for traveler safety. MnDOT has created a vertically integrated structure ensuring policies made at headquarters are implemented in the districts. A consistent level of investment effort across districts toward achieving statewide system performance targets was accomplished by establishing a consistent process and guidelines for district-level investment plans.

CASE STUDY: ASSET MANAGEMENT PLAN FOR SAFETY

CASE STUDY HIGHLIGHTS

- Establishes an objective and quantifiable methodology for allocating safety funding between various safety programs.
- Illustrates the implications of alternative investment decisions.
- Provides a basis for budgeting within the context of the State's overall ten year Capital Investment Strategy.

New Jersey takes an "asset management" approach to address transportation needs through its 10-year Statewide Capital Investment Strategy (SCIS), which recommends transportation programs based on goals, objectives, and performance measures. The SCIS identifies annual spending levels needed to achieve the performance objectives of the New Jersey DOT (NJDOT) and various transit agencies. The SCIS develops scenarios to estimate resulting system performance given different levels of funding, while staying within the fiscal constraints of available State transportation resources. Safety management is one of nine categories of investment within the SCIS.

A separate "Asset Management Plan for Safety" was developed to support the SCIS decision-making process to "make the right choices in investments in those safety programs that will provide for the greatest continual reduction in crashes, injuries, and deaths." This Plan is consistent with the overall goal of the State's Strategic Highway Safety Plan (SHSP) to "continually reduce the frequency and severity of crashes statewide." Underlying the Asset Management Plan is a Safety Management System (SMS), which is used in project selection and prioritization. The SMS provides a basis for "data-driven decision-making" that balances funding among the State's various safety programs.

Using these tools, New Jersey has established target service levels. Although a range of service levels and performance measures were established through the State's SHSP, the Long-Range Transportation Plan, and SCIS, they all have the common goal of continually reducing crashes, injuries, and deaths on the State's roadways. The Asset Management Plan presents specific service levels for the DOT's safety programs based on a number of identified locations per year along with an associated dollar value. For FY 2009, the annual targets for these programs included the following:

- **Intersection Improvement Program** – Improvements at 20 intersection locations;
- **Median Crossover Crash Prevention** – Construct 20 miles of median barrier treatments;
- **Accident Reduction Program** – Construct 10 skid-resistant sites;
- **Accident Reduction Program** – Implement improvements at 14 roadway departure locations;
- **Pedestrian Program** – Build 160,000 square yards of sidewalk along the state highway system, around schools and transit stations; and
- **Safe Corridor Program** – Review, recommend, and implement safety improvements along three Safe Corridors.

The Asset Management Plan defines performance scenarios for the entire Safety Investment Program based on the 10-year Statewide Capital Investment Strategy. The most recent scenarios are both funding-based and outcome-based as follows:

- Funding-Based Scenarios
  - Continued funding;
  - 25 percent decrease in funding; and
  - 25 percent increase in funding
- Outcome-Based Scenarios
  - Maintain condition level;
  - 50 percent backlog reduction; and
  - 100 percent backlog reduction (total need)

Based on scenario analysis, the State determined a 25 percent increase in funding would be necessary to maintain current conditions given no major unexpected safety needs. Any substantial reduction in the backlog of safety projects would require much higher investments in safety projects than currently were programmed.

Results

New Jersey conducted a strategic resource allocation process that applies performance measures to guide the determination of program investment targets to achieve agency goals and objectives over a 10-year period. Based on alternative funding scenarios, the Asset Management Plan for Safety identifies specific funding allocations for the State's individual safety programs. The Plan defines desired investment targets along with recommended constrained investment targets based on reasonable revenue expectations incorporated into the 10-year Statewide Capital Investment Strategy (SCIS), providing a basis for long-range capital planning for safety.

CASE STUDY: PROJECT PRIORITIZATION PROCESS

CASE STUDY HIGHLIGHTS

- Provides a rational, performance-based process for prioritizing projects for inclusion in the TIP.
- Applies safety-based criteria in the selection of projects, reflecting the goals of the Regional Transportation Plan.

In a typical year, the North Jersey Transportation Planning Authority (NJTPA) considers more than 300 project proposals eligible for funding in the Transportation Improvement Program (TIP). Given limited resources, NJTPA has developed a prioritization procedure consisting of the following two steps:

1. Application of Project Prioritization Criteria – During development of the Project Development Work Program, projects are evaluated and scored based on technical measures of how well they fulfill the goals of the Regional Transportation Plan (RTP). Scores are based on Project Prioritization Criteria (see below) and all eligible projects are ranked according to their scores.
2. Application of Additional Priority Factors – Factors such as the feasibility of project delivery, funding availability, and project timing also are taken into account. This evaluation involves consultation and negotiation among MPO staff, municipal staff and elected officials,, the State DOT, and local transit agencies.

NJTPA's current Regional Transportation Plan is guided by six policy goals, one of which is to "Maintain a safe and reliable transportation system in a state of good repair."[2] It is the stated intent of the RTP to translate these goals into specific actions, programs, and projects. The Project Prioritization Criteria enable NJTPA to select projects based on a system that awards points according to how well the project satisfies RTP goals. Criteria are grouped in accordance with the six goals of the RTP. The maximum number of points a highway and state bridge project can receive based on all selection criteria is 1,000. The maximum number of points that can be awarded within the criterion of Repair/Maintenance/Safety/Security is 286. Within this category, the criterion of "Will the project improve a safety problem?" is worth up to 110 points, which are awarded as follows:

- **High** – Safety improvements to roadways or intersections designated by the MPO or state DOT as safety priority locations or included in "Safe Corridor" programs. (110 points)
- **Medium/High** – Safety improvements to roadway segments where the severity-weighted accident rate exceeds that of the regionwide average for the same facility type. (83 points)
- **Medium** – Improvements to local roadways or pedestrian areas to address safety issues of local concern, e.g., traffic calming projects. (55 points)
- **Low** – Drainage, rockfall, and pavement rehabilitation/resurfacing projects. (28 points)

NJTPA staff administers the project prioritization process with participation by implementing agencies, the Regional Transportation Advisory Committee, and the Project Prioritization Committee of NJTPA's Board of Trustees. Project scores resulting from the process are considered during the development of the Capital Construction Program, which is the basis for development of the TIP.

Results

NJTPA applies a project prioritization process to rank projects according to their ability to satisfy the goals of NJTPA's Regional Transportation Plan (RTP). With improved transportation safety as one of the six goals of the RTP, the process enables NJTPA to consider safety in the evaluation of projects for inclusion in the TIP.

[2] Note that the RTP is currently going through an update.

CASE STUDY: DEVELOPING GOALS, OBJECTIVES, AND PERFORMANCE MEASURES

The Michigan Department of Transportation (MDOT) developed goals, objectives, and performance measures to provide strategic direction to its state long-range transportation plan and to establish a framework for tracking and reporting system performance. The process followed four basic steps: conduct background research, develop new goals and objectives, develop new performance measures, and apply new performance measures to plan analysis.

CASE STUDY HIGHLIGHTS

- Establishes a framework for developing goals, objectives, and performance measures.
- Develops performance measurement selection criteria to keep performance measures concise and meaningful.
- Incorporates expectations related to safety performance measures into department, work area, and individual level performance evaluations.

The Michigan Transportation Plan Team established a Performance Measure Subteam to work through the first three steps of the process. The team researched the goals, objectives, and performance measures in the current long-range plan and identified their pros and cons. Through a peer state review the team identified additional goals, objectives, and performance measure approaches for consideration. Public involvement activities with the Economic Advisory Group, stakeholders, and citizens helped the team gain insight into how stakeholders and citizens view system performance. The team developed seven performance measurement selection criteria, including the following:

1. Is the measure currently used by MDOT?
2. Is the measure in the current state long-range plan?
3. Does the measure indicate the level of achievement toward Michigan Transportation Plan goals?
4. Does the measure focus on one or more of the plan's emphasis areas – integration, economic benefit, and quality of life?
5. Do the measures adequately address a cross section of modes?
6. Is high-quality data readily available to support the measure?
7. Is the measure easily understood?

Following six performance workshops that identified the goals, objectives, and a short list of measures, changes in the goals and objectives were developed to reflect the current long-range plan goals, current and emerging agency priorities, the department mission, Federal planning factors, and the preferred public vision. To keep the strategic framework for the MI Transportation Plan simple and to establish a strong linkage between goals and objectives, the team identified four theme-based goal areas reflecting the Department's highest priorities: Stewardship, Safety and Security, System Improvement, and Efficient and Effective Operations. Objectives under each goal area were organized into three categories: 1) Integration; 2) Economic Benefit; and 3) Quality of Life. The team refined the list of recommended performance measures to 19 core measures and seven subordinate measures based on the selection criteria. The performance measures were presented and applied in a way that both reflects the plan's focus on integration and aligns with MDOT's program structure. Fatality rates and crash rates are two of the 19

core measures. Five subordinate measures are rail-roadway crossing crashes, local transit crashes, highway crashes, bicycle/pedestrian incidents/injuries, and deer-related incidents. The performance measures are used to support corridor-level analysis and development of statewide gap analysis.

The Michigan Transportation Plan goals and objectives link directly to MDOT's Strategic Plan. The Strategic Plan provides high level visionary guidance and practical direction as the department plans, develops, and implements an enhanced and integrated transportation system. Seven goals, of which one is safety, are aligned with the MI Transportation Plan and integrated into the department's implementation process.

Implementation of the MDOT Strategic Plan occurs at the department, work area, and individual levels. Teams implement a specific process or plan at the department-level. Work area objectives are identified and communicated through action plans that fulfill the Strategic Plan. Individual Employee Performance Plans set individual goals and competencies for employees based on the Strategic Plan's seven goals.

One goal of the MDOT Strategic Plan is to enhance and continue to improve safety within the transportation systems and workplace. Employee Performance Plans include expectations related to safety such as ensuring timely crash reports, complying with and enforcing personal protection equipment policy, keeping work zones compliant, and setting priorities based on safety risks to public, direct force, and contract agency crews.

Results

Performance measures established by MDOT provide a means for tracking performance with respect to stated goals and objectives, and support the development of investment scenarios and future decision-making. The measures also establish a basis for MDOT to measure progress in its long-range transportation plan implementation. Integrating safety-related performance objectives into department, work area, and individual-level performance plans provides specific actions for MDOT employees to take to improve safety. The MDOT Strategic Plan enhances the link between the MI Transportation Plan and department-level goals and objectives. Measuring performance helps the public understand how money is invested and why investment priorities are selected. MDOT is in the process of developing a web page to provide performance measures and progress to the public.

CASE STUDY: IDENTIFYING REGIONAL TRAFFIC SAFETY NEEDS

CASE STUDY HIGHLIGHTS

- Uses safety performance measure to prioritize regional investment decisions.
- Develops uniform approach to traffic safety analysis.
- Integrates regional goals, objectives, and performance measures into traffic safety analysis process.

Local governments play a key role in identifying regional traffic safety needs. Goals, objectives, and performance measures developed though the regional transportation planning process should reflect statewide planning efforts and be incorporated into problem identification and project selection processes at the local level. The Southeast Michigan Council of Governments (SEMCOG) incorporates safety planning goals and performance measures into its regional transportation planning process by aligning its long-range transportation plan with the State's Strategic Highway Safety Plan (SHSP), providing data analysis support for project identification to local governments, and using safety performance measures to plan investments. The SEMCOG Traffic Safety Program provides data collection and technical analysis support to local governments by identifying high-crash locations and recommending potential solutions. The program ensures data collection, technical analysis and planning processes support SEMCOG's long-range planning goals and objectives.

The region's long-range transportation plan identifies five strategic goals, one of which is to promote a safe and secure transportation system. SEMCOG developed performance indicators for each goal and identified data analysis tools to track and analyze each measure. SEMCOG's long-range transportation plan is aligned with the SHSP fatality goal to set target performance measures for the region.

SEMCOG has developed quantitative tools for relating investment to performance for the transportation system. The MPO uses an asset management approach to develop a regional transportation investment plan based on the benefits meeting-specific performance targets. The approach estimates the budget needed to achieve specific performance targets, one of which is safety. The tools allow the region to estimate the benefits of various investment scenarios and compare to system performance at current investment levels. The MPO determines the percentage of regional investments needed to meet the performance measure goals and prioritizes safety mitigation strategies. SEMCOG conducts an analysis of various scenarios for allocating available safety funds. Based on that analysis, an investment approach for funding various safety mitigation strategies is recommended. Safety mitigation strategies include intersection signal improvements, intersection geometric improvements (i.e., turn lanes), and segment improvements (i.e., median barriers and center left-turn lanes).

To promote a comprehensive approach to traffic safety analysis, SEMCOG provides a central location for traffic crash data and a Traffic Safety Manual, which describes a comprehensive approach to traffic safety analysis. The innovative traffic records system uses Geographic Information Systems (GIS) to spatially analyze crash data obtained from the Michigan Department of State Police's Criminal Justice Information Center (CJIC). Traffic data reports on specific intersections and segments of roadway are available. The traffic data reports, high-crash location, transportation data map, and intersection and roadway segments databases allow users to identify issues related to SHSP emphasis areas or view community profiles.

The Traffic Safety Program develops maps and deficiency analyses for each goal and performance measure area. SEMCOG identifies road segments and intersections with safety deficiencies related to the SHSP emphasis areas and tags crashes in the regional crash database related to specific emphasis areas. The MPO provides lists of deficiencies to its local governments so they can identify projects for the State's annual call for safety projects and consider them in long-range planning.

The Traffic Safety Manual provides guidance for local transportation planning, ranging from collecting potentially useful information to ranking potential solutions. The guide describes what data to collect and how to analyze data to identify high-crash locations. The Traffic Safety Manual describes how to propose and prioritize appropriate mitigation strategies using the same benefit/cost analysis incorporated into Michigan's annual call for safety projects.

Results

SEMCOG sets investment levels based on safety performance measures that align with statewide goals. The agency uses a comprehensive regional approach to identify and prioritize projects. SEMCOG provides crash data to local agencies for high-risk location analysis and cost-benefit analysis. This approach ensures local safety analysis and project prioritization is aligned with the region's and State's long-range goals, objectives, and performance measures. The region has exceeded the statewide goal of reducing traffic crash fatalities to one per 100 million vehicle miles traveled.

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